

Claims

1. A grain drill comprising:
- a frame having a plurality of wheels for supporting the grain drill during rolling over
  - 5 a surface of ground to be planted with grain;
  - a hopper for containing the seed grain to be planted in the ground;
  - a support which is joined to opposed sides of the frame and to spaced apart locations of the hopper
  - 10 to transfer weight of the hopper to the frame, the support including at least one weight sensing device which senses a weight of seed grain in the hopper transferred through the support to the frame and provides an output of the sensed weight of the seed
  - 15 grain in the hopper; and
  - a display, coupled to the output, for displaying the weight of the seed grain contained in the hopper.
2. A grain drill in accordance with claim 1
- 20 wherein the support comprises:
  - a pair of weight bearing supports which are respectively joined to the opposed sides of the frame, each weight bearing support including first and second vertical parts which are respectively attached to the
  - 25 hopper at the spaced apart locations separated along a longitudinal dimension of the grain drill and a horizontal part joined to the vertical parts and attached to the frame.

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3. A grain drill in accordance with claim 2 wherein:

the at least one weight sensing device comprises first and second load cells associated with each of the pair of weight bearing supports, the first load cell being loaded with weight transferred from the first vertical part to the horizontal part and the second load cell being loaded with weight transferred from the second vertical part to the horizontal part.

4. A grain drill in accordance with claim 3 wherein:

a first end of the first and second vertical parts is attached to the hopper and a second end of the first and second vertical parts is respectively attached to spaced apart locations of the horizontal part to transfer the weight of the seed grain in the hopper to the horizontal part; and

the horizontal part has first and second horizontal extensions, the first horizontal extension having a first end which is coupled to the frame and includes the first load cell and a second end which is deflected downward by the weight of the seed grain in the hopper and which is attached to the second end of the first vertical part and the second horizontal extension having a first end which is coupled to the frame and includes the second load cell and a second end which is deflected downward by the weight of the seed grain in the hopper and which is attached to the second end of the second vertical part.

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3. A grain drill in accordance with claim 1<sup>2</sup> wherein:

the ~~support~~ frame includes at each of the opposed sides a horizontal member, each horizontal member having at least first and second spaced apart holes extending vertically through the horizontal member and which respectively receive and allow vertical movement of a portion of the first and second vertical parts therein, the holes restricting horizontal movement of the hopper relative to the frame by confining the portion of the first and second vertical parts to within the holes.

4. A grain drill in accordance with claim 3<sup>3</sup> wherein the first and second vertical parts comprise:

15 a horizontal piece attached to one end of a vertical piece and another end of the vertical piece being the second end of the vertical part, at least one connector extending from the horizontal piece and through one of the holes and being vertically moveable therein and into engagement with the hopper.

5. A grain drill in accordance with claim 4<sup>4</sup> wherein:

a pair of connectors extend from the horizontal piece at opposed ends thereof spaced from a point of attachment of the vertical piece to the horizontal piece.

6. A grain drill in accordance with claim 6<sup>5</sup> wherein:

each connector is threaded and engages threads in the hopper at one of the spaced apart positions of the hopper.

10  
9. A grain drill in accordance with claim 5  
wherein:

the pair of connectors are threaded and  
respectively engage threads in the hopper at one of the  
5 spaced apart ~~positions~~ <sup>locations</sup> of the hopper.

12  
10. A grain drill in accordance with claim 4  
wherein:

a bushing is located in each hole and  
securely engages each connector to prevent horizontal  
10 movement of the engaged connector relative to the  
bushing.

14  
11. A grain drill in accordance with claim 5  
wherein:

a bushing is located in each hole and  
15 securely engages each connector to prevent horizontal  
movement of the engaged connector relative to the  
bushing.

7  
12. A grain drill in accordance with claim 6  
wherein:

20 a bushing is located in each hole and  
securely engages each connector to prevent horizontal  
movement of the engaged connector relative to the  
bushing.

11  
13. A grain drill in accordance with claim 10  
25 wherein:

a bushing is located in each hole and  
securely engages each connector to prevent horizontal  
movement of the engaged connector relative to the  
bushing.

22  
~~14.~~ A grain drill in accordance with claim 1  
 wherein:

the spaced apart locations are located at  
 four corners of the hopper and the support is attached  
 5 to the four corners by engagement with a bottom part of  
 the hopper.

~~15. A grain drill in accordance with claim 2~~  
 wherein:

the spaced apart locations are located at  
 10 four corners of the hopper and the support is attached  
 to the four corners by engagement with a bottom part of  
 the hopper.

16. A grain drill in accordance with claim 3  
 wherein:

15 the spaced apart locations are located at  
 four corners of the hopper and the support is attached  
 to the four corners by engagement with a bottom part of  
 the hopper.

21  
~~17.~~ A grain drill in accordance with claim 4  
 20 wherein:

the spaced apart locations are located at  
 four corners of the hopper and the support is attached  
 to the four corners by engagement with a bottom part of  
 the hopper.

20  
 25 ~~18.~~ A grain drill in accordance with claim 5  
 wherein:

the spaced apart locations are located at  
 four corners of the hopper and the support is attached  
 to the four corners by engagement with a bottom part of  
 30 the hopper.

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19  
 19. A grain drill in accordance with claim 4  
 wherein:

the spaced apart locations are located at  
 four corners of the hopper and the support is attached  
 5 to the four corners by engagement with a bottom part of  
 the hopper.

16  
 20. A grain drill in accordance with claim 5  
 wherein:

the spaced apart locations are located at  
 10 four corners of the hopper and the support is attached  
 to the four corners by engagement with a bottom part of  
 the hopper.

9  
 21. A grain drill in accordance with claim 6  
 wherein:

15 the spaced apart locations are located at  
 four corners of the hopper and the support is attached  
 to the four corners by engagement with a bottom part of  
 the hopper.

13  
 22. A grain drill in accordance with claim 10  
 20 wherein:

the spaced apart locations are located at  
 four corners of the hopper and the support is attached  
 to the four corners by engagement with a bottom part of  
 the hopper.

18  
 23. A grain drill in accordance with claim 17  
 25 wherein:

the spaced apart locations are located at  
 four corners of the hopper and the support is attached  
 to the four corners by engagement with a bottom part of  
 30 the hopper.

15  
~~24~~. A grain drill in accordance with claim ~~21~~ <sup>14</sup>  
 wherein:

the spaced apart locations are located at  
 four corners of the hopper and the support is attached  
 5 to the four corners by engagement with a bottom part of  
 the hopper.

~~25~~. A grain drill in accordance with claim ~~22~~ <sup>2</sup>  
 wherein:

the spaced apart locations are located at  
 10 four corners of the hopper and the support is attached  
 to the four corners by engagement with a bottom part of  
 the hopper.

12  
~~26~~. A grain drill in accordance with claim ~~13~~ <sup>11</sup>  
 wherein:

15 the spaced apart locations are located at  
 four corners of the hopper and the support is attached  
 to the four corners by engagement with a bottom part of  
 the hopper.

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~~27~~. A grain drill in accordance with claim ~~14~~ <sup>1</sup>  
 20 wherein:

each weight bearing support is mounted to not  
 extend in a direction along a width of the grain drill  
 beyond a width of a portion of the frame to which the  
 weight bearing support is attached.

25 ~~28~~. A grain drill in accordance with claim ~~2~~ <sup>5</sup>  
 wherein:

at least one weight bearing support has at  
 least a part extending in a direction along a width of  
 the grain drill part extending beyond a width of  
 30 a portion of the frame to which the weight bearing  
 support is attached.

29. A method for modifying a grain drill having a frame having a plurality of wheels for supporting the grain drill during rolling over a surface of ground to be planted with seed grain and a hopper joined to the frame for containing the seed grain to be planted comprising:

- raising the hopper upward from the frame to separate the hopper from being joined to the frame;
- positioning a support between the hopper and the frame to join the support to opposed sides of the frame and to spaced apart positions of the hopper to support the hopper in a raised position above the frame, the positioned support transferring weight of the hopper to the frame and including at least one weight sensing device which senses a weight of the seed grain in the hopper transferred through the support to the frame and which provides an output of the sensed weight of the seed grain in the hopper; and
- providing a display on the grain drill for displaying the weight of the seed grain contained in the hopper.

30. A method in accordance with claim 29 wherein the support comprises:

- a pair of weight bearing supports which are respectively joined to the opposed sides of the frame, each weight bearing support including first and second vertical parts which are respectively attached to the hopper at the spaced apart locations separated along a longitudinal dimension of the grain drill and a horizontal part joined to the vertical parts and attached to the frame.



31. A method in accordance with claim 30 wherein:  
 the at least one weight sensing device  
 comprises first and second load cells associated with  
 each of the pair of weight bearing supports, the first  
 5 load cell being loaded with weight transferred from the  
 first vertical part to the horizontal part and the  
 second load cell being loaded with weight transferred  
 from the second vertical part to the horizontal part.

32. A method in accordance with claim 31 wherein:  
 10 a first end of the first and second vertical  
 parts is attached to the hopper and a second end of the  
 first and second vertical parts are respectively  
 attached to spaced apart locations of the horizontal  
 part to transfer the weight of the seed grain in the  
 15 hopper to the horizontal part;  
 the horizontal part has first and second  
 horizontal extensions, the first horizontal extension  
 having a first end which is coupled to the frame and  
 includes the first load cell and a second end which is  
 20 deflected downward by the weight of the seed grain in  
 the hopper and which is attached to the second end of  
 the first vertical part and the second horizontal  
 extension having a first end which is coupled to the  
 frame and includes the second load cell and a second  
 25 end which is deflected downward by the weight of the  
 seed grain in the hopper and which is attached to the  
 second end of the second vertical part.

27  
 32. A method in accordance with claim 32 wherein:  
 the ~~support~~ frame includes at each of the  
 opposed sides a horizontal member, each horizontal  
 member having at least first and second spaced apart  
 5 holes extending vertically through the horizontal  
 member and which respectively receive and allow  
 vertical movement of a portion of the first and second  
 vertical parts therein, the holes restricting  
 horizontal movement of the hopper relative to the frame  
 10 by confining the portion of the first and second  
 vertical parts to within the holes.

28  
 33. A method in accordance with claim 33 wherein:  
 a horizontal piece attached to one end of  
 a vertical piece and another end of the vertical piece  
 being the second end of the vertical ~~part~~ <sup>part</sup>, at least one  
 15 connector extending from the horizontal piece and  
 through one of the holes and being vertically moveable  
 therein and into engagement with the hopper.

29  
 34. A method in accordance with claim 34 wherein:  
 20 a pair of connectors extend from the  
 horizontal piece at opposed ends thereof spaced from  
 a point of attachment of the vertical piece to the  
 horizontal piece.

30  
 35. A method in accordance with claim 35 wherein:  
 25 the pair of connectors are threaded and  
 respectively engage threads in the hopper at one of the  
 spaced apart positions of the hopper.

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 36. A method in accordance with claim 36 wherein:  
 a bushing is located in each hole and  
 30 securely engages each connector to prevent horizontal  
 movement of the engaged connector relative to the bushing.

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38. A method in accordance with claim 35 wherein:  
 a bushing is located in each hole and  
 securely engages each connector to prevent horizontal  
 movement of the engaged ~~connection~~ <sup>connector</sup> relative to the  
 5 bushing.

39. A grain drill in accordance with claim 29  
 wherein:

the spaced apart locations are located at  
 four corners of the hopper and the support is attached  
 10 to the four corners by engagement with a bottom part of  
 the hopper.

40. A grain drill in accordance with claim 29  
 wherein:

each weight bearing support is mounted to not  
 15 extend in a direction along a width of the grain drill  
 beyond a width of a portion of the frame to which the  
 weight bearing support is attached.

41. A grain drill in accordance with claim 29  
 wherein:

20 at least one weight bearing support has at  
 least a part extending in a direction along a width of  
 the grain drill part extending beyond a width of  
 a portion of the frame to which the weight bearing  
 support is attached.

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